App. No. 10/042,880
Art Unit: 2654

Docket No. 2001-0410

In the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (Currently Amended). A method for enhancing speech intelligibility of a speech signal, comprising ~~the steps of~~:

~~(a)~~ performing syllable segmentation on a frame of the speech signal in order to detect a syllable;

~~(b)~~ dynamically determining a scaling factor for a segment of speech in response to ~~step (a)~~ performing syllable segmentation on a frame of the speech signal in order to detect a syllable, wherein the segment is contained in the frame;

~~(c)~~ applying the scaling factor to the segment in order to modify a time scaling to the segment; and

~~(d)~~ blending the segment with an overlapping segment in order to essentially retain a frequency attribute of the speech signal that is processed, wherein:

the syllable is a time-scale modification syllable (TSMS) comprising a consonant-vowel transition and a steady-state vowel, and

dynamically determining a scaling factor for a segment of speech comprises:

setting the scaling factor to a first value, wherein time expansion occurs during the consonant-vowel transition; and

setting the scaling factor to a second value, wherein time compression occurs during the steady-state vowel.

2. (Canceled)

3. (Currently Amended) The method of claim [[2]] 1, wherein ~~step (b) comprises the steps of~~:

~~setting the scaling factor to a first value, wherein~~ the time expansion occurs during an approximate first one third of the TSMS[[;]], and

~~setting the scaling factor to a second value, wherein~~ the time compression occurs during an approximate next two thirds of the TSMS.

4. (Canceled)

5. (Currently Amended) The method of claim [[4]] 1, where ~~step (b)~~ dynamically determining a scale factor for a segment of speech further comprises:

setting the scaling factor to a third value, wherein time compression occurs during low energy regions of the speech signal.

6. (Original) The method of claim 5, wherein a time duration of the speech signal is essentially equal to a time duration of the processed speech signal.

7. (Currently Amended) The method of claim 1, further comprising ~~the step of~~:

~~(e)~~ modifying frequency domain characteristics of the speech signal in order that a transformed speech signal is characterized by enhanced acoustic cues.

8. (Currently Amended) The method of claim 7, wherein ~~step (e)~~ modifying frequency domain characteristics of the speech signal comprises:

adaptive spectral enhancing the speech signal, wherein a distinctness of spectral peaks of the speech signal is increased.

9. (Currently Amended) The method of claim 8, wherein ~~step (e)~~ modifying frequency domain characteristics of the speech signal further comprises:

emphasizing higher frequencies of the speech signal, wherein an upward spread of masking of the speech signal is reduced.

10. (Currently Amended) The method of claim 1, wherein ~~step (d)~~ blending the segment with an overlapping segment utilizes an algorithmic technique selected from the group consisting of an overlap-add (OLA) technique and a waveform similarity overlap-add (WSOLA) technique.

11. (Currently Amended) The method of claim 1, wherein ~~step (d)~~ blending the segment with an overlapping segment comprises ~~the steps of~~:

adding the overlapping segment with the segment if a correlation between the two segments is greater than a threshold; and

essentially retaining the segment if the correlation between the two segments is less than the threshold.

12. (Currently Amended) The method of claim [[2]] 1, wherein ~~step (a)~~ performing syllable segmentation on a frame of the speech signal comprises:

detecting a high energy region of the speech signal.

13. (Currently Amended) The method of claim [[2]] 1, wherein ~~step (a)~~ performing syllable segmentation on a frame of the speech signal comprises:

detecting abrupt changes in frequency-domain characteristics of the speech signal.

14. (Currently Amended) The method of claim [[2]] 1, wherein ~~step (a)~~ performing syllable segmentation on a frame of the speech signal comprises:

utilizing cross-correlation measures.

15. (Currently Amended) The method of claim [[2]] 1, further comprising ~~the step of~~:

amplifying a first portion of the TSMS in order to partially restore an associated energy in response to ~~step (c)~~ applying the scaling factor to the segment.

16. (Currently Amended) The method of claim 1, further comprising ~~the steps of~~:

~~(e)~~ determining a time delay associated with the segment; and

~~(f)~~ adjusting the scaling factor of a subsequent segment if the time delay is greater than a threshold in response to ~~step (e)~~ applying the scaling factor to the segment.

17. (Original) The method of claim 1, wherein the frequency attribute is a short-term Fourier Transform (STFT) of the speech signal.

18. (Currently Amended) The method of claim 1, further comprising ~~the step of~~:

~~(e)~~ outputting a processed speech signal to a telecommunications network in response to ~~step (d)~~ blending the segment with an overlapping segment.

19. (Currently Amended) The method of claim 1, further comprising ~~the steps of~~:

~~(e)~~ estimating a pitch component of the speech signal;

~~(f)~~ utilizing information about the pitch component ~~in step (d)~~ when blending the segment with an overlapping segment in response to ~~step (e)~~ estimating a pitch component of the speech signal; and

~~(g)~~ outputting a processed signal to a speech coder in response to ~~step (f)~~ utilizing information about the pitch component.

20. (Original) The method of claim 19, wherein the speech coder is selected from the group consisting of a code excited linear predication (CELP) coder, a vector sum excitation prediction (VSELP) coder, a waveform interpolation (WI) coder, a multiband excitation (MBE) coder, an improved multiband excitation (IMBE) coder, a mixed excitation linear prediction (MELP) coder, a linear prediction coding (LPC) coder, a pulse code modulation (PCM) coder, a differential pulse code modulation (DPCM) coder, and an adaptive differential pulse code modulation (ADPCM) coder.

21. (Currently Amended) The method of claim 1, further comprising ~~the step of~~:

~~(e)~~ outputting a processed speech signal to a speech coder in response to ~~step (d)~~ blending the segment with an overlapping segment.

22. (Currently Amended) A method for enhancing an intelligibility of a speech signal comprising ~~the steps of~~:

~~(a)~~ adaptive spectral enhancing the speech signal, wherein a distinctness of spectral

peaks of the speech signal is increased;

~~(b)~~ emphasizing higher frequencies of the speech signal, wherein an upward spread of masking of the speech signal is reduced;

~~(c)~~ extracting a frame from the speech signal;

~~(d)~~ calculating an energy contour and a spectral feature transition rate (SFTR) contour corresponding to the frame;

~~(e)~~ performing syllable segmentation utilizing the energy contour and the SFTR contour in order to detect a time-scale modification syllable (TSMS);

~~(f)~~ applying a scaling factor to a segment of speech, wherein the segment corresponds to a portion of the frame, comprising:

~~(i)~~ setting the scaling factor to a first value ~~if~~ when a consonant-vowel transition is detected within the TSMS, time expansion occurring during the consonant-vowel transition;

~~(ii)~~ setting the scaling factor to a second value ~~if~~ when a steady-state vowel is detected with the TSMS, time compression occurring during the steady-state vowel; and

~~(iii)~~ setting the scaling value to a third value for other portions of the speech signal;

~~(g)~~ determining an overlapping segment that is best-matched to the segment according to a cross-correlation and waveform similarity criterion;

~~(h)~~ calculating a time delay associated with the segment;

~~(i)~~ adjusting the scaling factor associated with a subsequent segment according to the calculated time delay ~~determined in step (h)~~;

~~(j)~~ overlapping and adding the segment and the overlapping segment; and

~~(k)~~ outputting a modified frame in response to processing all constituent segments of the frame.

23. (Currently Amended) A method for enhancing an intelligibility of a speech signal comprising ~~the steps of~~:

~~(a)~~ extracting a frame from the speech signal;

~~(b)~~ calculating an energy contour and a spectral feature transition rate (SFTR) contour corresponding to the frame;

~~(c)~~ performing syllable segmentation utilizing the energy contour and the SFTR contour in order to detect a time-scale modification syllable (TSMS);

~~(d)~~ applying a scaling factor to a segment of speech, wherein the segment corresponds to a portion of the frame, comprising:

~~(i)~~ setting the scaling factor to a first value ~~if~~ when a consonant-vowel transition is detected within the TSMS, time expansion occurring during the consonant-vowel transition;

~~(ii)~~ setting the scaling factor to a second value ~~if~~ when a steady-state vowel is detected with the TSMS, time compression occurring during the steady-state vowel; and

~~(iii)~~ setting the scaling value to a third value for other portions of the speech signal;

~~(e)~~ determining an overlapping segment that is best-matched to the segment according to a cross-correlation and waveform similarity criterion;

~~(f)~~ calculating a time delay associated with the segment;

~~(g)~~ adjusting the scaling factor associated with a subsequent segment according to the

calculated time delay ~~determined in step (h)~~;

~~(h)~~ overlapping and adding the segment and the overlapping segment; and

~~(i)~~ outputting a modified frame in response to processing all constituent segments of the frame.

24. (Currently Amended) A method for enhancing an intelligibility of a speech signal that is processed by a speech coder, comprising ~~the steps of~~:

~~(a)~~ extracting a frame from the speech signal;

~~(b)~~ performing syllable segmentation in order to detect a time-scale modification syllable (TSMS);

~~(c)~~ applying a scaling factor to a segment, wherein the frame comprises at least one segment, comprising:

~~(i)~~ setting the scaling factor to a first value ~~if~~ when a consonant-vowel transition within the TSMS is detected, time expansion occurring during the consonant-vowel transition;

~~(ii)~~ setting the scaling factor to a second value ~~if~~ when a steady-state vowel within the TSMS is detected, time compression occurring during the steady-state vowel; and

~~(iii)~~ setting the scaling factor to a third value for other portions of the frame;

~~(d)~~ estimating ~~the~~ a pitch component of the frame;

~~(e)~~ determining an overlapping segment that is best-matched to the segment according to a cross correlation and waveform similarity criterion, and to the speech component if the frame has a voiced characteristic;

~~(f)~~ combining the segment with an adjacent segment, comprising:

~~(i)~~ overlapping and adding the segment and the overlapping segment if a correlation between the segment and the overlapping segment is greater than a threshold; and

~~(ii)~~ essentially retaining the segment if the correlation between the segment and the overlapping segment is less than the threshold; and

~~(g)~~ outputting a modified frame to the speech coder in response to processing all constituent segments of the frame.

25. (New) A method comprising:

performing syllable segmentation on a frame of the speech signal in order to detect a syllable;

dynamically determining a scaling factor for a segment of speech in response to performing syllable segmentation on a frame of the speech signal in order to detect a syllable, wherein the segment is contained in the frame;

applying the scaling factor to the segment in order to modify a time scaling to the segment; and

blending the segment with an overlapping segment in order to essentially retain a frequency attribute of the speech signal that is processed, wherein:

performing syllable segmentation on a frame of the speech signal in order to detect a syllable comprises detecting abrupt changes in frequency domain characteristics of the speech signal.

26. (New) The method of claim 25, wherein dynamically determining a scaling factor for a segment of speech comprises:

setting the scaling factor to a first value, wherein time expansion occurs during an approximate first one third of the TSMS; and

setting the scaling factor to a second value, wherein time compression occurs during an approximate next two thirds of the TSMS.

27. (New) The method of claim 25, wherein dynamically determining a scaling factor for a segment of speech comprises:

setting the scaling factor to a first value, wherein time expansion occurs during the consonant-vowel transition; and

setting the scaling factor to a second value, wherein time compression occurs during the steady-state vowel.